IMPORTANCE OF RUMEN PH MONITORING IN DAIRY CATTLE

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INTRODUCTION

Dairy cattle have very well developed rumen microbial ecosystem, which is characterized by the presence of a large variety of microbial consortium. This ecosystem contains bacteria (10^{10}-10^{11} cell/ml, representing more than 50 genera), ciliate protozoa (10^{4}-10^{6} cell/ml from 25 genera), anaerobic fungi (10^{3}-10^{5} zoospores/ml, representing 5 genera) and bacteriophages (10^{8}-10^{9}/ml) (Mackie *et al*., 1996).The weight of rumen (10-15% of body weight of animal) itself explains its importance in digestion and metabolism of cattle. The enzymes produced by the microbial consortia are helpful to digest lignocellulosic feed in the diet of dairy cattle. None of the enzymes of animal origin have ever been found able to degrade lignocellulosic feeds. These microbial enzymes are boon to the dairy cattle if adequate environment (pH) is present in the rumen ecosystem.

Over the last few decades, due to intensive cross breeding programme, the productivity of dairy cows in Kerala have increased greatly. As a result, high energy density diets, which are high in grain starch/highly soluble starch but low in forage, are often fed to the dairy cows in order to meet the high energy demand during the lactation. The most nutritionally challenging time for dairy cows is the early lactation period, during which their feed intake still not fully developed but milk production increases quickly. Dairy farmers, then, tend to push the grain content in the diets to an even higher level in order to meet the dairy cow's productivity potential. Moreover the availability of fodder in Kerala is very low and this situation further worsens the ecosystem of rumen by reducing the pH.

OCCURRENCE OF SUBACUTE RUMINAL ACIDOSIS (SARA)

Naturally ruminants are designed to eat fibrous grasses, plants, and shrubs, which are digested slowly in rumen. In contrast, grains are high in rapidly fermentable carbohydrates that are rapidly broken down by ruminal microorganisms, and leads to the accumulation of acids in the rumen and a lower rumen pH. When rumen pH drops too much, the growth of many ruminal bacteria is inhibited, and concentration of toxic compounds in rumen digesta increases. This can lead to impaired animal health, including decreased feed intake and milk fat production, lowered body condition, inflammation of rumen, liver abscesses, and laminitis related hoof lesions. These signs indicate that dairy cows suffer from Sub acute Ruminal Acidosis (SARA). SARA is common in most of the high producing animals of Kerala which also leads to infertility.

MONITORING AND MANAGEMENT OF RUMEN pH

Effective rumen pH control is critical in maintaining a healthy rumen. Most of the diets in ruminants produce acidic products in the rumen and these are buffered with bicarbonate produced in saliva. A 400 kg cow can deliver as much as 100 liters per day of saliva rich in bicarbonate, phosphate and urea. The rate of saliva production is variable throughout the day depending on whether the cow is resting, eating or ruminating. A greater quantity of saliva is produced during rumination and the period, an animal spends ruminating depends on the active fiber of the diet. The management of microbial populations in the rumen is achieved by diet and through pH control.

Rumen pH fluctuates diurnally between nearly neutral before morning feeding and acidic after feeding. When cows are fed by high forage diets, rumen pH can be maintained between 6 and 7, which is considered to be the optimum for cellulolytic bacteria (Mould *et al*., 1983). Ruminal pH may decline periodically below 6 when dietary grain content increases. Generally, SARA occurs when ruminal pH stays in the range of 5.2 and 6 for a prolonged period. It is challenging to set up a specific threshold of rumen pH for defining SARA, since rumen pH varies among different sites inside the rumen. The use of different techniques to collect rumen fluid for pH determination introduces further variation. The highest rumen pH usually observed in the cranial dorsal sac, followed by the cranial ventral, caudal ventral, and the caudal dorsal sac. Rumen pH in the ventral sac and the center of rumen solid mat is the lowest (Shen *et al*., 2012). When rumen fluid is collected using an oral-stomach tube, the specific collection site is unknown but the sample will often be collected from the cranial dorsal sac and it could be contaminated by saliva. In contrast, rumen fluid collected via rumenocentesis is from the ventral sac. Duffield *et al.* (2004) observed that the pH of rumen fluid samples collected by a stomach tube was on average 0.35 pH units higher than the pH of rumen fluid samples collected by rumenocentesis. Oro-ruminal probes (Geishauser, 1993) and rumen cannulae were used but proved unsatisfactory for accurately characterising the dynamic pattern in rumen pH. The first attempts to continuously measure rumen pH in cattle (Lampila 1955) used in-dwelling glass electrodes in cannulated animals connected by a wire to a receiver located outside the rumen. In 1993, Dado and Allen developed a system enabling constant measurement of rumen pH in animals maintained in stanchions but reported difficulties in maintaining calibration of the electrode due to static build up, faulty solid-core electrode leads, and rumen fluid leakage. Recently, a new device has been reported, using a wireless indwelling probe, called a bolus (Mottram *et al*, 2008). The bolus measures pH continuously, stores the data and transmits it telemetrically via an in-built radio transmitter to a receiver station located around the cow. It gave reliable data for up to 40 days (Phillips *et al.*, 2010). In recent times, bolus technology has been improved and continuously recording rumen pH telemetry can give accurate data for over 150 days and can continue to be downloaded for 7 months after insertion.

CONCLUSION

Infertility and hoof problems are very common in most of the cross bred (HF-Cross) dairy cattle of Kerala. This situation is mostly made due to the fluctuation in the normal pH of rumen and often most of the cows are in sub acute ruminal acidosis. So it is very much essential to manage the pH of rumen for proper absorption of nutrients through ruminal epithelium and for preventing toxic end products of unwanted metabolism. It is observed that adequate amount of fodder (fibre) is essential to maintain the neutral pH

by providing salivary buffers from chewing activity. Introducing rumen pH bolus (wireless telemetry) in dairy farms of Kerala may help to monitor the pH of rumen. Further it helps to prevent acidosis and alkalosis and also helps to modify the diet to get neutral pH in rumen. Cost effective rumen pH bolus should be made available to dairy farmers to monitor the pH of rumen for saving the dairy cattle of Kerala.

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